Cooperative Artefacts and Spatial Representations

Overview and Outlook

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Overview

• Motivation by an application scenario
• Cooperative Artefacts
  – Framework for smart objects
• Spatial algorithm for Cooperative Artefacts
• Future research directions
• Discussion and questions
Application Scenario

Cooperative Artefacts\(^1\) (CAs)

- Framework for reasoning with smart objects
- Distributed reasoning without external infrastructure
- Assessment of context based on:
  - domain knowledge
  - observation of the world
  - domain rules
  - sharing of knowledge with other CAs

Cooperative Artefacts (2)

Hardware

• Two nodes
  – US distance measurements
  – CA framework
• Based on Particle Smart-its
  – PIC18F6720 (5 MIPS)
  – Program Memory: 128KB
  – Data Memory: 3.8KB RAM, 1KB internal EEPROM
  – External Memory: 32KB EEPROM
Spatially Aware Reasoning

- A container has to identify containers in a certain proximity
- **Range queries necessary**: \( \text{inRange}(A,B,r) \)
- Relate US technology has measurement range of around 2-4m
- Longer distances have to be inferred
- Low-complexity algorithm is important
  - Relative positioning isn’t necessary because only distances are needed.
Algorithm (1)

Algorithm (2)

- Measurements are shared among all nodes
- A constraint propagation algorithm is used to infer distances to “hidden” nodes
- Each node models network as a fully connected distance graph
  - range query is a simple lookup
Algorithm (3) - Evaluation

- We used simulation in the design process of the algorithm
  - Analysis of inferred intervals
  - Determining optimal parameters for our range query algorithm
- Simulation was used to evaluate accuracy
  - Random networks of 200 nodes
- In small real sensor network we showed the feasibility of our approach

Outlook (1)

- A model of a cooperative artefact
- Multiagent System (Jennings et al.)
  - A multiagent system is a system that has these four properties:
    - each agent has incomplete information, or capabilities for solving the problem, thus each agent has a limited viewpoint;
    - there is no global system control
    - data is decentralised; and
    - computation is asynchronous
Outlook (2)

• Cooperative Artefact framework is a first approach to this idea
  – Sensors
  – Actors
  – Rule-based cooperative reasoning
• We want to look into certain aspects:
  – Coordination – distributed decision
  – Communication – solving a problem, negotiating with others, exchanging knowledge
  – Common knowledge – What do other agents know? Do they know what I know? “Social conventions”

Questions and Discussion

• Agent idea in a preliminary stage
  – Input, Suggestions ?
• Spatial algorithm paper is under submission
• General questions?